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EFFECT OF SOLID STORAGE ON THE UNIFORMITY OF FINAL MOISTURE CONTENT OF KILN DRIED LUMBER

Harvey H. Smith[1/]

John R. Dittman[2/]

Commercial kiln schedules are designed to dry lumber as rapidly as possible, consistent with an allowable amount of drying degrade, and an acceptable final average moisture content. Other factors must also be considered, such as uniformity of moisture content throughout each board and from board to board within the charge. Drying stresses are also an important consideration. They are normally removed by a final stress relief treatment.

The study reported here was designed to learn something about the effect of solid or bulk storage of kiln dried lumber on the uniformity of the final moisture content. Kiln dried lumber will tend to become more uniform in moisture content as a result of the equalizing effect of time. Total moisture content of the entire lumber pile or unit will show little change during storage, but differences of moisture content within an individual board should be favorably altered by an equalizing period. These differences may be due to the moisture gradient that develops during drying, which produces boards with a relatively dry surface but higher moisture content in the interior. Fast drying may also cause differences in moisture content from section to section of a board.

Shop and Better grades of lumber that are to be remanufactured require drying to a lower and more uniform final moisture content than dimension lumber. This is particularly true for lumber that will be

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1/ Forest Products Technologist, Pacific Southwest Forest and Range Experiment Station, Berkeley, California.

2/ Sawmill Superintendent, Winton Lumber Company, Martell, California.

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glued and lumber that will be used indoors. For this study five-quarter Shop and Better ponderosa pine was used as representing a lumber item that normally is dried to meet much more exacting final moisture content specifications than dimension. White fir and other species are expected to respond to storage in a similar manner. To the extent this is true, the results of this study should have wide application.

Procedure

The procedure for studying the effect of solid or bulk storage on final moisture content was relatively simple with the equipment available. An automatic continuous moisture meter, capable of marking lumber that is both too wet and too dry, was used in metering the study lumber. Only lumber marked as too wet was used in the study. The meter is equipped with two electrodes, each 4 inch x 14 inch in area, positioned to scan each board across its full width at a position about 3 feet and 10 feet from one end (fig. 1).

Both electrodes normally activate the one inking device that marks the boards wherever the moisture content is either above or below preset limits. When both electrodes are operating, there is no indication of which activates the inking device. Boards that contain a wide variation of moisture content when green may not be uniformly dry after kiln drying in a relatively fast commercial schedule. Such boards are often marked as too wet in one area and too dry in another area. Therefore, to insure metering and remetering in exactly the same place on each study board, only one electrode was used (fig. 2).

The meter was first calibrated by using sample boards having a uniform moisture content in the optimum range (8 to 10 percent) for measuring with an electrical moisture meter. A portable, hand moisture meter with 1-inch insulated pins was used to determine the maximum moisture content of the sample boards. The continuous, automatic meter was adjusted to accept lumber within an average maximum moisture content range of 10 through 12 percent. Boards above 12 percent were automatically marked as too wet and boards below 10 percent were automatically marked as too dry. With only one electrode operating, the marks are inked on each board in those specific areas across the width that are above or below the preset moisture content limits.

Lumber marked as too wet was pulled from the dry chain to make up two solid-piled carrier units of study lumber. As the boards were pulled from the dry chain the length of the marks was measured and recorded.

Moisture readings with a portable, hand moisture meter with 1-inch long insulated electrodes were made in the same areas of each board scanned by the automatic meter. The moisture content of the lumber in the study units was found to be from 12+ to 16 percent.

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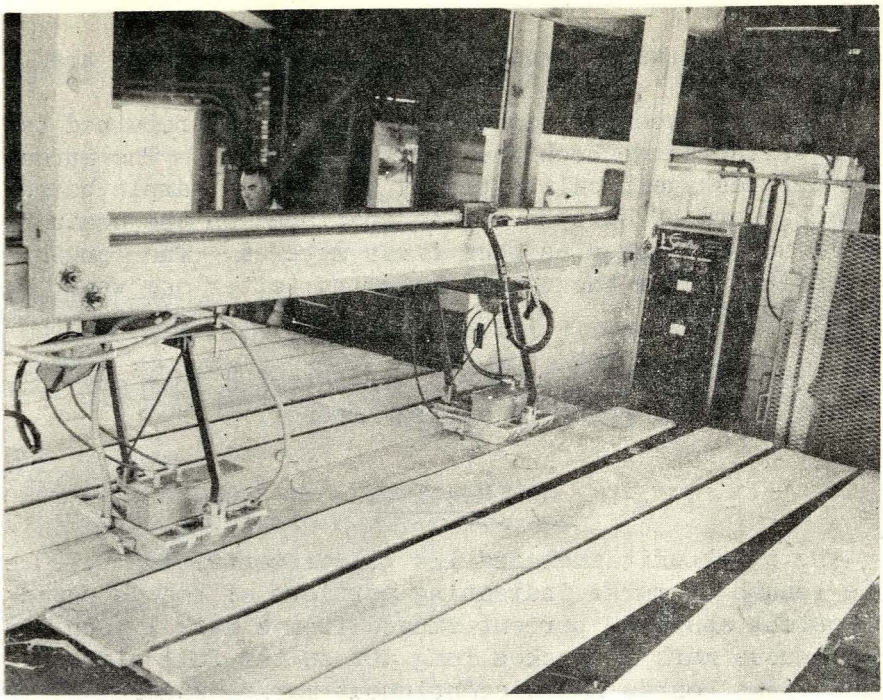

Figure 1.--Automatic, continuous electrical moisture meter for measuring the moisture content of all lumber passing over the dry-chain.

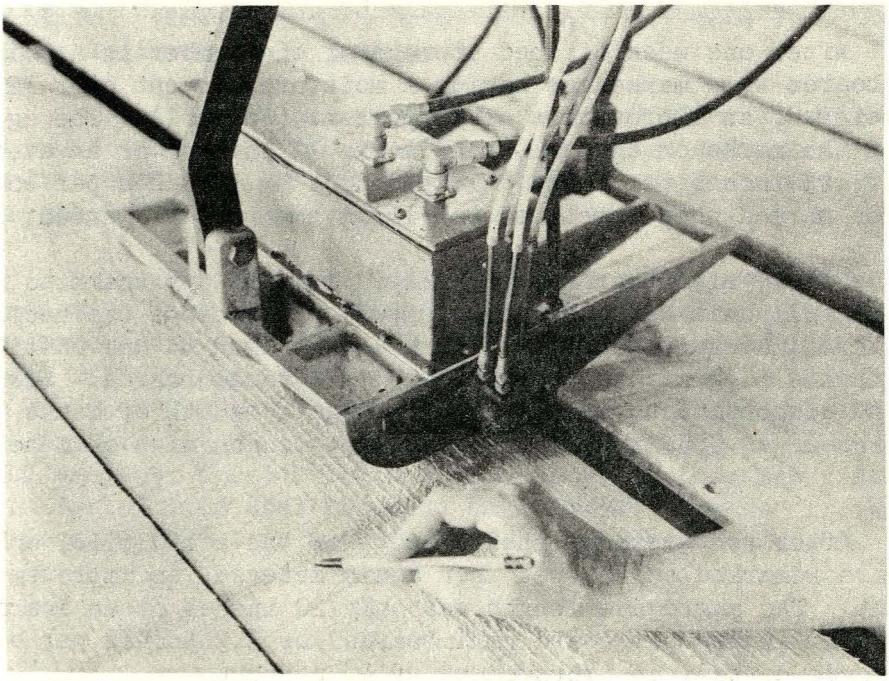

Figure 2.--Electrode with inking device for marking lumber that is either above or below a preset moisture content.

Both units were moved to a covered dry-storage shed.

After one week of storage Unit No. 1 was returned to the dry chain for metering to recheck the moisture content. The automatic moisture meter was again calibrated by the use of sample boards as before. Each board of Unit No. 1 was postioned on the chain to be remetered in the same area as when first metered. The length of each ink mark resulting from the second metering (after one week) was measured and recorded.

After two weeks Unit No. 2 was returned from dry storage to the dry chain for remetering in similar manner.

Results

The first unit included 124 boards containing 2,720 board feet. The length of marks indicating portions of boards having a moisture content above 12 percent ranged from a mark 1 inch long up to one continuous mark 23 inches long across the full width of individual boards. Some boards had discontinuous marks, usually no more than 2 marks, though 2 boards were recorded as having 3 marks. These broken marks indicate wet streaks in the lumber.

The aggregate length of marks when first metered equaled 1,138 inches, or an average length of 9.2 inches per board.

After one week of shed storage of the lumber in a solid pile, only 10 boards were marked as having a moisture content over 12 percent when remetered, an improvement of 92 percent (table 1). The aggregate length of the marks on these 10 boards was 31 inches, or an average length of .25 inches per board (all boards), or 3 inches per board of the boards marked when remetered, an improvement of 97 percent.

Ninety-nine boards were pulled from the dry chain to make up the second full unit of bulk piled lumber. No footage was recorded. The length of marks ranged from a mark 1 inch long to one continuous mark 22 inches long across the width of individual boards. Sixteen boards had discontinuous marks. The aggregate length of marks when first metered was 955 inches, or an average length of 9.6 inches per board.

After two weeks of shed storage of the solid pile, only 6 boards were remarked as too wet when again metered, an improvement of 94 percent. The aggregate length was only 20 inches or an average length of .20 inches per board (all boards) or 3.3 inches per board of the boards marked, an improvement of 98 percent.

Conclusion

Bulk or solid storage of kiln dried 5/4 ponderosa pine Shop and Better lumber had a beneficial effect on the moisture distribution

Table 1.--Effect of storage on moisture content of solid piled lumber

Method of Measure	Unit 1 (stored 1 week)	Unit 2 (stored 2 weeks)
Number of boards		
Number of boards per unit (marked too wet)	124	99
Number acceptable when remetered after storage	114	93
Percent acceptable after storage	92	94
Length of line		
Inches per unit when first metered	1,138	955
Inches when remetered after storage	31	20
Percent improvement after storage	97	98

within individual pieces. Areas of high moisture content were greatly reduced. The exact path of this moisture movement was not determined. Presumably, the greatest movement was in a direction across the thickness of the lumber, resulting in a more uniform moisture content from midthickness to the surface. There may have been some movement of moisture across the width of the lumber, from areas of high concentration to areas of low concentration. There may also have been some movement from board to board, but this is believed to be small.

The units were not weighed before and after storage. Such weight figures would indicate a change in total moisture content. The change in total moisture content during 1 or 2 weeks of solid storage would be expected to be small.

One week of storage made a pronounced improvement in the uniformity of moisture content. A second week of storage resulted in only slight further improvement. The results of the 1- and 2-week storage indicate beneficial effects can be expected from storage shorter than 1 week. A similar study, using shorter storage periods, could be made to indicate how much improvement can be effected by less than a week's storage. Further, in a similar study consideration should be given to using a species, grade, and thickness of wood that normally has a greater range of final moisture content--such as 5/4 or 6/4 white fir Shop and Better lumber.

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